RECORDING FORAGING SEABIRDS AT SEA
STANDARDISED RECORDING AND CODING OF FORAGING BEHAVIOUR AND MULTI-SPECIES FORAGING ASSOCIATIONS

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Camphuysen, C.J. & Garthe, S. 2004. Recording foraging seabirds at sea. Stadardised recording and coding of foraging behaviour and multi-species foraging assocations. Atlantic Seabirds 6(1): 1-32. *The European Seabirds at Sea (ESAS) database was established in the early 1980s using a common format. It contains the results of ship-based and aerial seabird surveys in the Northwest European waters, collected using standard methods. The emphasis has always been on mapping distribution patterns and variations in relative abundance, from which seabird abundance estimates for certain sea areas could be made. The data have been used first to evaluate different sea areas in terms of their vulnerability for surface pollutants. Later studies put more emphasis on ecological aspects underlying seabird distribution and from this work a growing need for more adequate, but still standardised, coding of behaviour types emerged. In this manual, a coding system is introduced that allows specific coding of associations of birds and marine mammals with certain surface phenomena (including land), coding of multi-species feeding associations (feeding flocks) and coding of a variety of behaviour types, with emphasis on feeding behaviour and foraging interactions. In this coding method, the original aim and style of data collecting of seabirds at sea remains intact, and new data are therefore directly comparable with historical material. The coding is thought to be of interest for ESAS participants as well as other groups studying the behaviour of seabirds at sea.*

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INTRODUCTION

During most of the 20[th] century, seabirds at sea were studied only occasionally and as a matter of opportunity (Jespersen 1930; Bierman & Voous 1950). Particularly since the late 1970s, however, systematic aerial and shipboard seabird surveys have been conducted in many parts of the world. Bailey & Bourne (1972) stressed the need for uniformity of counting methods, to ensure that observations made by different observers and in different sea-areas are comparable. Although global standardisation of methods has never been achieved, despite serious attempts and comparisons of different methods, regional standardisation has been a major step forward in obtaining consistent and comparable results (Brown *et al.* 1975; Tasker *et al.* 1984; Van Franeker 1994; White *et al.* 1999). In north-west European waters, the establishment of the European Seabirds At Sea (ESAS) database, in which a number of institutes from countries around the North Sea store data in a common format following recommendations of standard recording techniques (Tasker *et al.* 1984), has been a particularly fruitful example of standardisation, subsequent co-operation and data collection (Tasker *et al.* 1987; Webb *et al.* 1990; Camphuysen & Leopold 1994; Skov *et al.* 1995; Stone *et al.* 1995; Offringa *et al.* 1995; Garthe *et al.* 2003).

In Europe, many of these surveys were designed to collect basic information on distribution and relative abundance of seabirds at sea (Tasker *et al.* 1984; Komdeur *et al.* 1992), often following the desire to categorise different sea areas in terms of their vulnerability for surface pollutants (Skov & Durinck 1992; Carter *et al.* 1993; Williams *et al.* 1995). Published comments on standardised methods often aimed at greater precision in abundance (biomass) estimates (Briggs *et al.* 1985; Diamond *et al.* 1986; Gaston *et al.* 1987; Baptist 1990), specific modifications to obtain better results for particular species (Offringa & Leopold 1991), or were pointing at shortcomings or difficulties with census techniques (Dixon 1977; Griffiths 1981; Gaston & Smith 1984; Ryan & Cooper 1989; Van der Meer & Camphuysen 1996).

Several seabird studies have concentrated on the influence of oceanographic parameters on seabird distribution, particularly by unravelling patterns in prey availability (e.g. Kinder *et al.* 1983; Haney & McGillivary 1985; Springer & Roseneau 1985; Harrison *et al.* 1990, Hunt 1990; Hunt *et al.* 1990; Piatt 1990; Schneider 1990; Haney 1991; Elphick & Hunt 1993; Davoren *et al.* 2002, 2003). In spite of quite a few small- and meso-scale studies (Leopold *et al.* 1986; Joiris 1989; Skov *et al.* 1989; Harrison *et al.* 1994; Skov *et al.* 1995b; Garthe 1997), such aspects are still not fully developed in and around the North Sea. Between 1992 and 1995, ship-based surveys in the North Sea were conducted during studies of seabirds utilising fishery waste and of the effect of fishing fleet distribution on spatial patterns in seabird abundance (Garthe & Hüppop 1994; Camphuysen *et al.* 1995a; Camphuysen & Garthe 1997). More recent projects focused on natural foraging areas for piscivorous seabirds off the Scottish east coast (Wanless *et al.* 1998; Camphuysen & Webb 1999). In many of these studies, oceanographical data or information on fish abundance (e.g. during acoustic surveys) is collected simultaneously with the routine seabird census. In these projects, however, there was an increasing demand to facilitate the systematic registration of certain behavioural aspects, most notably if, and if so how, recorded birds were actually foraging and/or feeding. Certainly the ESAS coding system offered very limited possibilities to record behavioural aspects and partial modifications of the standard software took place with at least some ESAS participants.

Hunt *et al.* (1988), Maniscalco & Ostrand (1997), Camphuysen & Webb (1999), and Silverman & Veit (2001) described the importance of multi-species feeding associations (MSFA's), flocks in which some species (producers) facilitate others (joiners, scroungers, kleptoparasites) by their particular feeding activities. Underwater predators, including marine mammals, large predatory fish and diving seabirds, were found to herd prey or drive prey to the surface, thereby offering surface feeding seabirds foraging opportunities that would otherwise not have existed (Grover & Olla 1983; Ostrand 1999; Clua & Grosvalet 2001). The frequency and functioning of such groups can only be studied at sea, and as with single-species foraging behaviour, there was an increasing demand to establish a system to record these and similar phenomena in a systematic, standardised approach (Camphuysen & Webb 1999).

In this paper we describe a coding system for different types of foraging behaviour (basically following Ashmole 1971) and for several aspects of MSFA formation using classifications in Camphuysen & Webb (1999), as a separate coding module on the standard ESAS system of data storage. So, while the basics (recording relative abundance at sea) remain intact and unaltered, observers can decide to add on or leave out information on foraging behaviour and group formation in the birds they record. We are aware that the coding may be of interest primarily for ESAS-participants and -users, but we trust that our basic descriptions of procedure and expected results may facilitate those with a more general interest in studies of seabirds at sea. The field-methods, although up to now constantly subject to further refining, have been in use since 1997 and have been tested thoroughly on aspects such as clarity (do observers understand what is meant), ease to remember and use at sea, convenience, and database query results in the analysis phase. Meanwhile, Schwemmer & Garthe (2004) published a paper on the behaviour of Lesser Black-backed Gulls *Larus fuscus* in the south-eastern North Sea. That work is based to a substantial extent on the classification shown in this paper.

METHODS

The following applies only to ship-based seabird surveys, outlined in Tasker *et al.* (1984), Komdeur *et al.* (1992), and Camphuysen *et al.* (2004). Traditionally, ESAS database files typically include a base component (including information on date, time, place, observers, and environmental conditions) and a bird component (records of birds and marine mammals). The proposed coding system only affects the bird component, except that in the base file the observer should indicate that behavioural observations were (or were not) included as a standard practice. The potential to code particular associations (for example with a fishing vessel, the own ship, or with a group of whales), direction of flight, and their behaviour, as well as potential prey and the potential formation of multi-species groups requires 3 database fields (Direction of flight/ associations – Behaviour - Prey).

The behavioural codes now proposed fit into the database fields Direction of flight/associations (or 'A-codes') and Behaviour ('B-codes'), and either code fits in only one of the two fields [A and B refer to the respective database columns, and are not part of the code, that is a short numeric field only]. Direction of flight and association (A) codes are listed in Appendix 1, behaviour (B) codes are fully listed and explained in Appendix 2. Prey codes ('P-codes') are listed in a separate text section (Recording prey).

RECORDING NUMBERS OF SEABIRDS AT SEA

Following Tasker *et al.* (1984), the recording of birds within a 300m wide strip transect in 1-, 5- or 10-minute intervals and with a snapshot for flying birds is retained as the methodological backbone of ESAS database. A 180° or 90° scan operated simultaneously was originally mainly intended to record scarcer seabirds. Scan data cannot be used to calculate densities (n/km^2), but the scan offers opportunities to enlarge the sample of multi-species seabirds associations and marine mammal/seabird assemblages (see below). The perpendicular distance of swimming birds is recorded relative to the transect line ahead of the ship: A = 0-50m, B = 50-100m, C = 100-200m, D = 200-300m, E = >300m, W = within 300m, but no distance recorded. For flying birds, coded with F, there is no distance indication.

COLLECTING BEHAVIOURAL DATA

Direction of flight The rationale behind records of direction of flight is that (sea-)birds move from A to B on purpose. Searching (foraging) birds may seem to move more or less randomly over the sea (code #1). Birds coded with a direction of flight must have a distance code 'F' by default, while marine mammals travelling about may combine a 'direction of flight' code with an indicator of swimming ('A'-'E' or 'W'). Nine codes are reserved for direction of flight, including #1 (no apparent direction) and #2-9 (octagon, N → NW; Appendix 1). Although there is no immediate need to cancel or stop collecting these data, we rank them as 'low' priority in comparison with the below aspects, summarised under 'associations'. For specific studies, however, such as recording seabird movements near colonies (flying to and fro), directions of

Scavenging Northern Gannets, Northern Fulmars and Great Skuas at a fishing vessel off Fair Isle, summer 2003, trawler. Such birds are coded as 'scavenging at trawler' (code #B 41), irrespective of precise feeding techniques. Association code #A 26 (associated with fishing vessel) applies also. Visafval bij elkaar scharrelende Jan-van-genten, Noordse Stormvogels en Grote Jagers bij een vissersboot bij Fair Isle, zomer 2003. Dergelijke vogels worden gecodeerd als 'visafval etend bij vissersschip' (code #B 41), onafhankelijk van de precieze foerageermethoden. Associatiecode #A 26 (geassioceerd met vissersboot) is hier eveneens van toepassing *(C.J. Camphuysen)*

flight may be of great significance (*cf.* Schneider *et al.* 1990; Camphuysen *et al.* 1995b).

Associations (A-codes) Fairly often, we can actually see where the birds are heading for, or why they are on a given spot: for example, a fishing vessel (#A 26), an offshore platform (#A 23-24), or perhaps an oceanographical front (#A 12-13). In those cases, it is of greater significance to code their goal (association) rather than their direction of flight. Therefore, within the same database field, and with priority over direction of flight, codes for 'associations' of seabirds with certain surface phenomena are provided (Appendix 1). Association codes have been devised for birds associating with near-surface fish shoals (#A 10) or marine mammals (#A 11), with floating objects such as wood (#A 14), rubbish (#A 15), oil slicks (#A 16), or sea weed (#A 17), with fronts in sea (often indicated by distinct lines separating two water masses or concentrations of flotsam) (#A 12-13), with the own observation base (#A 18-

20) (by default not in transect), with buoys (#A 22), markers (#A 25), other vessels (#A 22), offshore installations (#A 23-24), sea-ice (#A 27) or with land (#A 28-29).

A group of birds flying towards a distant fishing vessel can now be coded as flying with F under distance, and as associated with fishing vessel with code #A 26. The behaviour field (see below) should be left blank, to separate approaching birds from actual scavengers around the vessel, either 'searching' for prey, actually feeding, or perhaps resting near the ship (see behaviour codes below and in Appendix 2). Similar combinations can be made for birds flying towards or resting near land, or birds flying in association with or towards a front, overruling the 'direction of flight' code that would not have been particularly informative. Note that for "colony-flights", certainly so in areas where numerous smaller colonies are found scattered along the coast, an accurate indication of the direction of flight is more important than the fact that the birds were homing in (or leaving) a particular breeding area. Recent studies of fish-transporting auks in Scottish waters have demonstrated that different colonies utilised different sea areas simultaneously, and the direction of flight indicator was a crucial bit of information in that analysis (IMPRESS project, *in prep*).

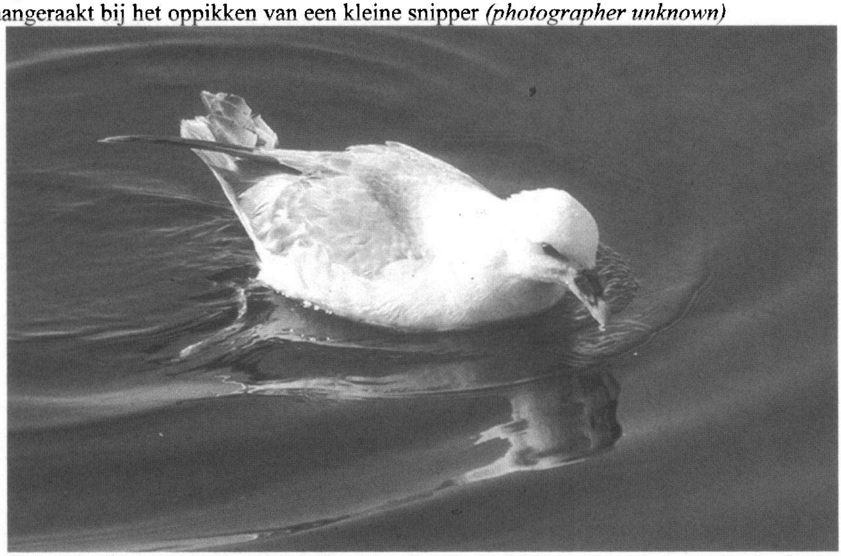
Foraging behaviour (B-codes) Types of foraging behaviour were characterised following Ashmole (1971), but with some modifications such as the split use of *'scavenging'* for birds feeding at fishing vessels (#B 41) and birds scavenging on a corpse (#B 40), plus a distinction between *'surface seizing'* (#B 43; few, large prey) and *'surface pecking'* (#B 44; many, tiny prey). For use in shallow seas such as the Danish, German and Dutch Wadden Sea, *'wading'* (#B 34; including filtering or probing for prey) and *'scooping'* (#B 35, as in pelicans) were added. Scooping appeared to be of significance also for Northern Gannets utilising sandeels Ammodytidae in deep water. Contrary to Ashmole, there is no separation between wing- and feet-propelled diving, because we do not want to code what we cannot actually see. One of the most interesting aspects of test-cruises was that certain seabirds did not always feed the way they should have done typically according to text books, but may change feeding techniques in particular situations. All available B-codes are listed in Appendix 2.

An approaching ship will trigger escape reactions of seabirds on the track line. Aerial species may simply fly off, but pursuit diving species such as auks may dive to escape from the vessel. It is up to the observer to discriminate between 'feeding dives' (#B 48) and 'escape dives' (#B 93), but in case of doubt we recommend to refrain from coding.

Deep plunge diving Northern Gannets and swimming Northern Fulmars in the wake of a trawler. Such birds are coded as 'scavenging at trawler' (code #B 41), irrespective of precise feeding techniques. Association code #A 26 (associated with fishing vessel) applies to all ship-followers depicted. Diep (stoot)duikende Jan-van-genten en zwemmende Noordse Stormvogels in het zog van een trawler. Dergelijke vogels worden gecodeerd als 'visafval etend bij visssersschip' (code #B 41), onafhankelijk van de foerageermethode. Assocatiocode #A 26 (geassocieerd met vissersboot) geldt voor alle afgebeelde scheepsvolgers *(C.J. Camphuysen)*

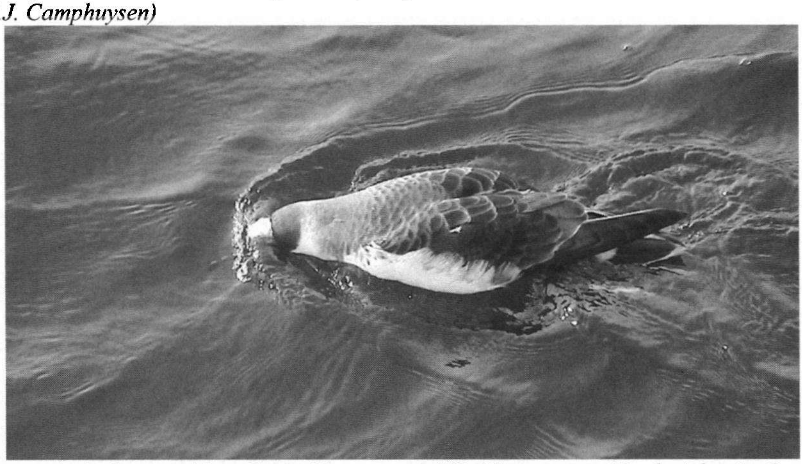
Adult Little Gull dipping (#B 42) at front or line in the sea as indicated by foam streaks at the surface (association #A 13), river Elbe. The difference between dipping and shallow plunging is not always that obvious and the bird shown here could be coded as shallow plunging (#B 46) as well. Dwergmeeuw dippend (#B 42) bij een front of een lijn in de zee, aangeduid door schuimstrepen op het zeeoppervlak (associatiecode #A 13), rivier de Elbe. Het verschil met ondiep duiken is niet altijd duidelijk. De afgebeelde vogel kan ook als ondiep duikend (#B 46) gecodeerd worden *(S. Garthe)*

Dipping Pomarine Skua (#B 42, IJmuiden harbour, The Netherlands, autumn 1985), with the water only just hit while picking up a small morsel. Dippende Middelste Jager (#B 42, haven IJmuiden, najaar 1985), waarbij het water nauwelijks wordt aangeraakt bij het oppikken van een kleine snipper *(photographer unknown)*



Surface pecking (code #B 44). Northern Fulmar feeding on dead, floating Euphausiacea in the central North Sea. Oppervlakte pikken (code #B 44). Noordse Stormvogel foeragerend op dode, drijvende Euphausiacea in de centrale Noordzee *(C.J. Camphuysen)*

Actively searching Northern Gannet (#B 49). Searching gannets look down, often circle over certain areas or at least frequently alter course. In the central North Sea, searching gannets are often associated with marine mammals (dolphins or porpoises, association code #A 11). Actief zoekende Jan-van-gent (#B 49). Zoekende Jan-van-genten kijken naar beneden en cirkelen vaak boven bepaalde gebieden of wijzigen hun koers op z'n minst regelmatig. In de centrale Noordzee zijn zoekende Jan-van-genten vaak geassocieerd met zeezoogdieren (dolfijnen of bruinvissen, associatiecode #A 11) *(C.J. Camphuysen)*

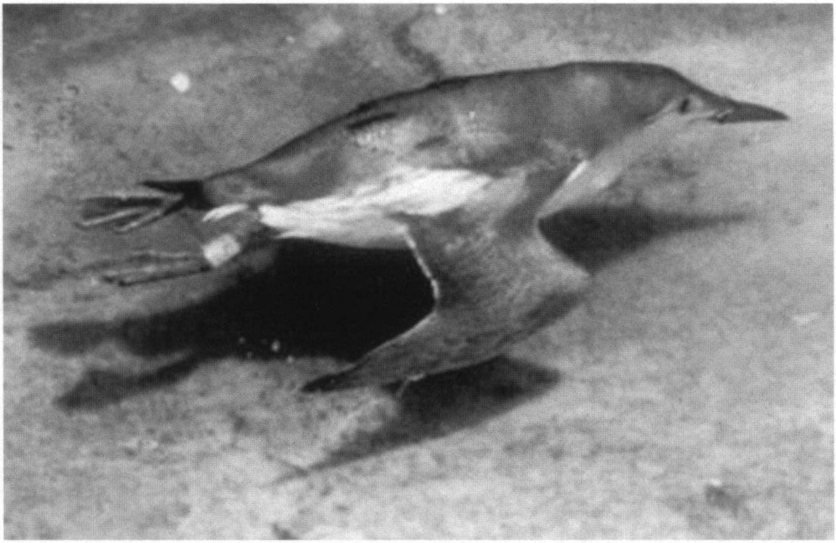


Actively searching Great Shearwater (#B 49), western North Atlantic Ocean. Searching shearwaters may stay airborne, but when swimming, shearwaters, auks, divers and several other birds continue searching for prey by peering under water. Actief zoekende Grote Pijlstormvogel (#B 49), westelijke, Noord-atlantische Oceaan. Zoekende pijlstormvogels kunnen dit al vliegend doen, maar als ze zwemmen zoeken ze -evenals alkachtigen, duikers en diverse andere soorten- verder door onder water te kijken *(M.L. Tasker)*

Herring Gulls and Lesser Black-backed Gulls surface pecking (#B 44), searching (#B 49), dipping (#B 42), and shallow plunging (#B 46) in association with a river plume front (#A 12) off Hoek van Holland, 10 June 2002. Zilver- en Kleine Mantelmeeuwen die van het oppervlakte pikken (#B 44), zoeken (#B 49), dippen (#B 42) en ondiep duiken (#B 46), geassocieerd met een rivierwaterfront (#A 12) voor Hoek van Holland, 10 juni 2002 (*(M. Poot)*

Plunge diving (code #B 45 or 46) or dipping (code #B42). Lesser Black-backed Gull feeding on swimming crabs (prey code #P 41) in the eastern North Sea. The final behaviour code depends on the entry into the water: completely disappearing out of sight (deep plunging, #B 45), entering the water but with the wing tips still visible (shallow plunging, #B 46), or barely touching the water surface while picking up prey (dipping, #B 42). Stootduiken (code #B 45 of 46) of dippen (code #B 42). Kleine Mantelmeeuw foeragerend op zwemmende krabben (prooicode #P 41) in de oostelijke Noordzee. De definitieve gedragscode is afhankelijk van de diepte die bereikt wordt: geheel uit zicht verdwijnend (diep duiken, #B 45), in het water verdwijnend, maar de vleugelpunten blijven zichtbaar (ondiep plonsduiken, #B 46) of het wateroppervlak slechts toucheren terwijl prooi wordt opgepikt (dippen, #B 42) *(S. Garthe)*

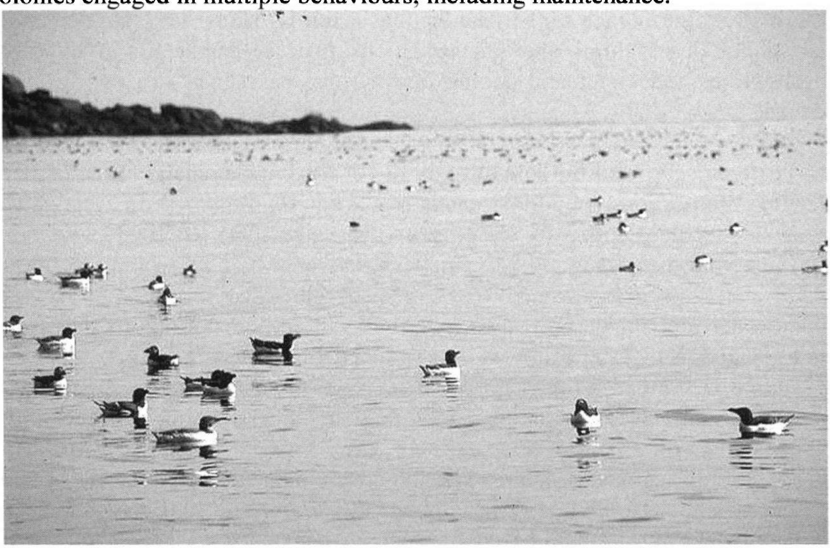
Opposite page (bottom). Aerial pursuit. The kleptoparasite (juvenile Great Black-backed Gull on the right) will be coded #B 36 for aerial pursuit, while the victim (adult Herring Gull) will have behaviour code #B 90 (under attack by kleptoparasite). Kleptoparasites on water are coded as #B 68. Achtervolging in de lucht. De kleptoparasiet (juveniele Grote Mantelmeeuw rechts) wordt gecodeerd als #B 36, (achtervolging in de lucht), terwijl het slachtoffer (adulte Zilvermeeuw) gedragscode #B 90 (aangevallen door kleptoparasiet) krijgt. Kleptoparasieten op het water worden gecodeerd als #B 68 *(S. Garthe)*



Underwater pursuit dive (#B 48) by a Common Guillemot in captivity. This code is reserved for diving birds such as divers, grebes, cormorants, seaduck and auks, bottom feeding or foraging in an underwater pursuit, that dive from a swimming position. Escaping birds, disturbed by an approaching ship for example, should not be included. Onderwater achtervolgingsduik (#B 48) door een Zeekoet in gevangenschap. Deze code is gereserveerd voor duikende soorten als duikers, futen, aalscholvers, zee-eenden en alkachtigen die duiken vanuit een zwemmende positie om op de zeebodem te foerageren of om hun prooi onder water te achtervolgen. Deze code is niet van toepassing op vogels die vluchten, bijvoorbeeld voor een naderend schip *(photo NIOZ)*

Of particular interest is the coding of 'searching' seabirds (#B 49). The idea is that seabirds actually 'foraging' (looking for prey) in a given area can be separated from those that are just there, even though the latter might use a sudden feeding opportunity. Potential feeding areas do not necessarily show off by the presence of actively feeding seabirds; prey density may for example be low or prey may be difficult to detect. Although any migrating seabird may interrupt swift flight to pick up a prey encountered by coincidence, observers familiar with seabirds at sea will agree on the concept of separating actively searching individuals from birds that simply move about. Searching albatrosses and petrels circle consistently over certain patches (Veit & Prince 1997), with the head constantly pointing down or sideways. Searching Northern Gannets *Morus bassanus* and terns may follow straight lines, but while peering down constantly and usually with slower wing-beats than while flying long distances during migration. Shearwaters may settle and alight repeatedly, moving apparently randomly over an area, constantly reacting to one another. Auks, divers, cormorants and some shearwaters extensively peer under water (they may do that also when disturbed by a ship, perhaps as a check of a route to flee). Gulls circle and hover repeatedly during their searches, skuas looking for options to kleptoparasitise 'stalk' and fly low before preparing their attacks. All those (and more examples) can be coded with #B 49, but it does not harm to make additional notes on paper for future reference.

General behaviour (B-codes) Besides foraging, seabirds can engage in a variety of other activities that one may wish to record. Nocturnal feeders may sleep a lot during the day, while birds that have recently been engaged in a feeding frenzy often rest on water and preen (#B 66) or sleep (#B 60), as they may even be incapable of flying away. Mostly during spring, seabirds frequently perform courtship displays at sea (#B 61), including courtship feeding (#B 62), copulation (#B 63), the handling of nest material (#B 64), or chick guarding (#B 65). Other coded activities include circling high (#B 69) and birds in colony rafts (#B 67), a behaviour code reserved for large flocks of birds near breeding colonies engaged in multiple behaviours, including maintenance.



Colony rafts (#B 67), a behaviour code reserved for large flocks of birds "rafting" at sea near breeding colonies engaged in multiple behaviours, including maintenance. Shown are rafts of Atlantic Puffins, Common Guillemots and Razorbills off the Shiant Islands, W. Scotland. Met de kolonie geassocieerd (#B 67), een gedragscode die is gereserveerd voor grote groepen vogels in de omgeving van broedkolonies die op zee zwemmen, waarbij ze verschillende gedragingen, inclusief poetsen, kunnen vertonen. Hier groepen Papegaaiduikers, Zeekoeten en Alken bij de Shiant Eilanden, West-Schotland *(C.J. Camphuysen)*

MULTI-SPECIES FEEDING ASSOCIATIONS

All birds, whether swimming or flying, that operate 'together' or stay tight in a particular area or in a particular movement are marked as distinct 'flocks'. Flocks comprising more than one species are called 'multi-species feeding associations' (MSFA's). Recent studies have shed some light on composition, structure and dynamics of MSFA's of seabirds (Sealy 1973; Hoffman *et al.* 1981; Porter & Sealy 1982; Maniscalco & Ostrand 1997), and on the specific role of different species in mixed-species assemblages (Bayer 1983; Grover & Olla 1983; Chilton & Sealy 1987; Hunt *et al.* 1988; Mahon *et al.* 1992; Camphuysen & Webb 1999; Ostrand 1999). MSFA's may be formed around fishing vessels (scavenging seabirds), in association with cetaceans and around sources of more natural prey (fish, plankton, carrion). Many MSFA's are formed by surface feeding or shallow plunging seabirds over concentrations of prey driven to the surface by underwater predators (predatory fish, cetaceans, seals or seabirds). Current knowledge suggests that these flocks represent an important behavioural mechanism in the exploitation of resources of food that are 'normally' out of reach for surface feeding seabirds. There is a great demand for additional observations and quantifications that we might fill in by careful descriptions and systematic coding of what can be seen at sea during routine cruises.

Camphuysen & Webb (1999) evaluated the available literature and terms and categorisations of the role of seabirds (or marine mammals) in multi-species feeding associations. Important categories are (1) *initiators* (birds that actually start the feeding frenzy by locating a subsurface food patch), (2) *joiners* or *scroungers* (birds streaming into patches discovered by others) and (3) *divers* or *beaters* (*producers;* animals that often trigger MSFA formation by their underwater activities). To categorise a bird correctly according to this system, individuals need to be followed and watched for some time. This is not often available in standard cruises. Prior knowledge of existing group structures and potential dominance hierarchies does help in understanding and recognising what is going on.

Prey searching seabirds altering course that, for example start hovering over a potential feeding patch, are labelled as *initiators* (#A 51). Finding those will be tricky during ship-based transects at considerable speed, but previous experiences have taught us that flock initiators can be identified regularly (Camphuysen & Webb 1999). If only one species participates in the frenzy (for example driven by auks or other predators under water), this species can be labelled as initiator (#A 51). All the species streaming in the developing feeding frenzy are labelled as *joiners* (#A 52), from which we try to identify the *scrounger* type (#A 53). We define scroungers as seabirds joining MSFA's in an

Typical multi-species feeding association (MSFA) with approaching Northern Gannet (#A 52, #B 49), scooping gannets (#B 35) that exclude the dipping (#B 42) and searching (#B 49) Kittiwakes that initiated the flock (#A 51), produced by social feeding Common Guillemots (initially #A 56, #B 48) that now leave the scene as a result of the feeding gannets that act as scroungers (#A 53), summer 2004, off the Scottish east coast. MSFA coding is complicated and when specific roles in the frenzy are not understood, association code #A 50 should be used. The careful combination of association codes and behaviour codes gives the opportunity of a full description of the event in no-time, at least under favourable circumstances. Kenmerkende MSFA (associatie van meerdere soorten foeragerende zeevogels), met naderende (#A 52, #B 49) en scheppende Jan-van-genten (#B 35) die dippen (#B 42) en zoekende (#B 49) Drieteenmeeuwen van de groep uitsluiten. Deze Drieteenmeeuwen hebben een initierende rol gespeeld bij het opbouwen van de groep (#A 51), die is onstaan door gezamenlijk foeragerende Zeekoeten (aanvankelijk #A 56, # B 48). De Zeekoeten verlaten de MSFA als gevolg van de foeragerende Jan-van-genten die zich als zogenaamde klaplopers -'scroungers'- gedragen en andere soorten het foerageren onmogelijk maken *(C.J. Camphuysen)*

aggressive or dominant manner, thereby excluding other species from feeding opportunities. MSFA participants that can not be attributed to any of the above roles are simple coded as 'MSFA participant' (#A 50).

Underwater prey may be driven towards the surface by *divers*, (*producers* of the feeding frenzy), facilitating surface feeders driving prey up in the water column or even by temporarily keeping prey near the surface. These herding predators *produce* the foraging opportunities for surface feeders and these can be marine mammals (Clua & Grosvalet 2001) or diving seabirds (Grover & Olla 1983; Camphuysen & Webb 1999). Diving seabirds are thought to be capable of herding only by concerted action, for example by simultaneous dives. It is of significance to observe such MSFA's with the question in mind: do the diving birds dive randomly as solitary individuals (#A 54), or do they apparently co-ordinate their activities in small groups (#A 56)? *Beaters* are animals that disturb prey by their (foraging) behaviour so that it subsequently becomes available for other predators. The classic example is grazing cattle with associated swallows or Cattle Egrets *Bubulcus ibis* catching disturbed insects that become available. At sea, the typical beater is a (group of) whale(s) or a dolphin school disturbing or chasing prey (#A 55) that can subsequently be exploited by associated, surface-feeding or (relatively) shallow plunge diving seabirds (#A 11).

Hofmann *et al.* (1981) described three types of MSFA's, and we dealt so far only with the smallest variety (Type I; small, short-lived flocks over tightly clumped prey; Table 1). To be able to attribute certain sightings to the other two types, much larger groups or assemblages that do not act as cohesive units, we have introduced #A 57 and #A 58 (Appendix 1). Type II MSFA's (#A 57) are larger and longer-lasting flocks formed over prey that apparently do not act as cohesive units, whereas Type III MSFA's (#A 58) is reserved for very large flocks formed where local water-mass discontinuities concentrate zooplankton or fish such that large concentrations of predators exploit the area, but where the concentration cannot be seen as "a group" of animals. It will have to be information stored in the Behaviour column to shed light on the activity and type of behaviour of members of these greater flocks. Previous experiences have learned that certainly Type III MSFA's can be recognised best with hindsight.

A final category of MSFA, meant to split off feeding frenzies where none of the predators is the producer but where a prey patch is attacked jointly, is the "drive hunt" MSFA (#A 59). Near-surface fish shoals are attacked by complex flocks of top-predators and these hunts typically move by, to follow the prey, where front positions need be established and re-established constantly by both diving and surface feeding seabirds. Typical drive hunts occur over vast schools of sardines in South Africa and capelin in arctic ecosystems, but drive hunts have been observed also over schools of clupeids and sandeels in the North Sea. Even auks behave as shearwaters, by taking wing and plunging back in the water to start an underwater pursuit. Drive hunts are commonly approached by foraging whales, but the difference with the smaller type MSFA's is that, if any underwater predator is in control or is influencing the school formation near the surface, it is neither a seabird, nor a cetacean (Table 1, Type B).

Table 1. Three types of MSFA's (following Hofmann et al. *1981) and five forms of associations between cetaceans and seabirds (following Pierotti 1988), from Camphuysen & Webb 1999.*

Tabel 1. Onderscheiden typen samengestelde groepen foeragerende zeevogels (naar Hofmann et al. *1981) en verschillende associaties tussen vogels en zeezoogdieren (naar Pierotti 1988), uit Camphuysen & Webb 1999.*

Multi-species feeding associations (Hoffman *et al.* 1981)	
Type I	Small, short-lived flocks over tightly clumped prey
Type II	Larger and longer-lasting flocks formed over prey that apparently do not act as cohesive units
Type III	Very large flocks formed where local water-mass discontinuities involved downwelling, concentrating zooplankton and small fish
Forms of association between seabirds and marine mammals (Pierotti 1988)	
Type A	Birds and mammals that occur in close proximity to one another, but do not appear to interact
Type B	Cetaceans and birds that seem to be attracted to the same resource, but do not show any positive attraction to each other
Type C	Birds that appear to be actively drawn to marine mammals because of the foraging activities of the mammals drive or otherwise force prey to the surface where birds have access to a resource that would otherwise be unavailable
Type D	Birds scavenging by-products of marine mammals (e.g. scraps of prey, faeces)
Type E	Marine mammals as predators of seabirds; birds showing avoidance behaviour

Pierotti (1988) proposed a useful distinction between five categories of seabird/marine mammal assemblages (Table 1). However, we feel it is no point coding Type A, while Types B-C can be dealt with by carefully using combinations of MSFA/Association, Behaviour and Prey codes as proposed in this article. For example, Type C cetaceans should have a code for 'beating' (#A 55), while Type B cetaceans could be coded as MSFA-'members' (#A 59 or #A 50), or 'joiners' (#A 53 or #A 54). Type B seabirds should not receive an Association code #A 11 but rather an MSFA code (#A 59). Type E marine mammals could have behaviour #B 76, while type E seabirds should receive behaviour #B 92. Type D seabirds should receive Association code #A 11, Behaviour #B 49 (or any other foraging activity), and prey #P 57 (see Recording Prey).

FURTHER CODING

Marine mammals (B-codes) Most seabird observers under ESAS record marine mammals as if they were birds. To facilitate a rapid description of observed behaviour, we propose 20 behaviour codes that would suit most needs (Appendix 2). Most codes are fairly straightforward and simply describe what is visible at the surface, such as various swimming modes (slow swimming, #B 70, fast swimming, #B 72, or escape behaviour from an approaching ship, #B 71), aerial displays such as 'breaching' (vertical leap out of the water, #B 73) or 'acrobatic leaps' (reserved for frequent and particularly spectacular and 'playful' leaps of dolphins above the surface, #B 86), and other visible types of behaviour ('basking' (floating) at the surface, #B 79; spy-hopping, #B 80; lob-tailing, #B 81; tail or flipper slapping, #B 82; sexual behaviour such as copulating, #B 87; and play, #B 88). Resting seals (haul-out, B# 89) may be combined with association codes as appropriate (for example sea ice, #A 27; land, #A 28; sand banks, #A 29, or even an offshore platform, #A 24; or buoy, #A 22).

Marine mammals often react to vessels and dolphins are famous as bow-riding creatures. Bow-riding dolphins may be coded as #B 74, while all other approaches should be categorised under #B 83 (approaching ship, not bow-riding). For mammals that are barely visible, for example only detected thanks to a blow or some splashes, codes #B 84 and 85 may apply. Young whales and dolphins are normally coded in the age/plumage columns of the database, but their position relative to the adult animals can be coded by using #B 77 (calves that stay close to an adult, usually swimming slightly behind the adult animal 'at the tail'), or #B 78 (calves that swim freely in a herd).

Foraging behaviour is more difficult to judge from a steaming vessel and only two codes have been suggested so far: #B 75, herding behaviour (where animals surround prey and drive it up towards a given area to commence feeding) and #B 76, 'other' feeding behaviour. Lunge-feeding baleen whales could be coded #B 76.

Misfortune, disease and death (B-codes) Ten codes are reserved for 'birds under stress', including deceased individuals (Appendix 2). Injured (#B 95), entangled (#B 96), oiled (#B 97), otherwise 'sick' (#B 98) or even dead animals (#B 99) may be encountered in places and seabirds under attack by other animals can be coded with the system provided below. Note that dead birds and mammals are by default out of transect. The simplest form of distress is an escape dive away from the approaching observation platform (#B 93), but this code is normally only used for flightless groups of seaduck and auks.

Recording prey (P-codes) Finally, as one of the most difficult tasks at sea, it may be possible to recognize prey caught or targeted by seabirds at sea. The ultimate record does not only include place, species, age and plumage, but also association, behaviour, and prey. Prey data are stored in a separate column in the birds file under ESAS and several of a potential of 100 codes (0-99) are attributed to various prey, summarised as follows:

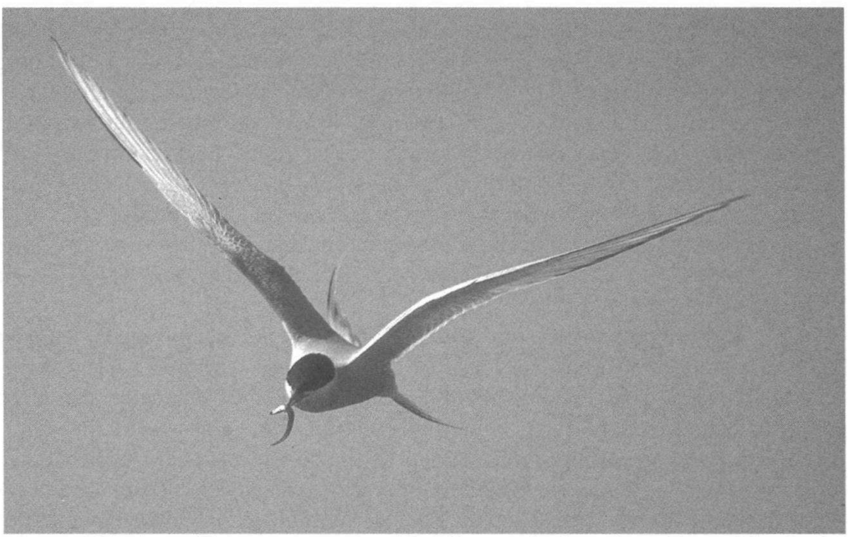
Fish prey (#P 10) fish, no further details, (#P 11) small fish, unidentified (ca. bill length), (#P 12) medium fish, unidentified (ca. 2-5x bill length), (#P 13) large fish, unidentified, difficult to handle, (#P 14) sandeel ball, (#P 15) clupeid ball, (#P 16) unidentified fish ball, or (#P 17) capelin ball at surface, (#P 20) gurnard, (#P 21) herring or sprat, (#P 22) sandeel, (#P 23) gadoid fish, (#P 24) flatfish, (#P 25) regurgitated fish after aerial pursuit, (#P 26) salmon, (#P 27) capelin, (#P 28) eel;

Miscellaneous prey (#P 30) small particles, unidentified, (#P 31) large object, unidentified, (#P 32) jellyfish, (#P 33) squid, (#P 34) worm (e.g. *Nereis*), (#P 35) barnacles, Balanidae, (#P 36) oil from oily slick, (#P 40) crustacean, unidentified, (#P 41) swimming crab, (#P 42) starfish, (#P 43) sea urchin, (#P 45) bivalve, unidentified, (#P 46) mussel;

Carrion and corpses (#P 50) carrion or big corpse, unidentified, (#P 51) seal carcass, (#P 52) whale or dolphin carcass, (#P 53) bird carcass, (#P 54) litter, rubbish, (#P 55) regurgitated unidentified prey after aerial pursuit, (#P 56) bird kill (e.g. by Great Skua), (#P 57) excrements (e.g. from whales), (#P 58) kitchen scraps, (#P 59) bread;

Discards and offal (#P 60) fishery waste, unidentified, (#P 61) discarded roundfish, (#P 62) discarded flatfish, (#P 63) discarded offal, (#P 64) discarded benthic invertebrate, (#P 65) discarded starfish, (#P 66) discarded crustacean (e.g. shrimp)

Nest material (#P 70) seaweed



Adult Arctic Tern carrying prey (#B 30) towards the colony, Farne Islands, July 2003. In cases like this, where the prey can be identified as sandeel, a prey code may be applied (#P 22). Adulte Noordse Stern met prooi (#B 30) op weg naar de kolonie, Farne Eilanden, juli 2003. In gevallen als deze, waarbij de prooi geïdentificeerd kan worden als zandspiering, kan een prooicode (#P 22) toegekend worden *(C.J. Camphuysen)*

GROUPING DATA

Database queries are likely to include or exclude specific categories and therefore, a short-cut to find these is required. Actively foraging seabirds can be selected by choosing Behaviour codes #B 32-49 and #B 68. Those participating in any multi-species feeding frenzy can be found by selecting #A 50-59 in the Association column of the data. Resting or preening is selected by choosing #B 60, 66, 67, and 69 under Behaviour. Birds association with the observation platform are found by selecting #A 18-20 in the Association column. Similar selections for any other grouping may be made and kept as standard queries to successfully identify key activities in any of the collected material.

DISCUSSION

The great benefit of detailed behavioural coding is that potential correlations between the presence of seabirds and certain oceanographical or other factors driving prey availability will be stronger if we are capable of discriminating, for example, only those birds that were actually feeding from those that were just there, perhaps only by coincidence. This method has proven to be rewarding, especially for a detailed analysis (Camphuysen & Webb 1999; Camphuysen 2002). This method will provide insight in diurnal patterns in activity and group formation (Camphuysen 1999), will give information on the functioning of fronts causing fluctuations in prey availability, and on foraging ranges around colonies. Based on the codings described in this paper, Schwemmer & Garthe (2004) analysed area utilisation by Lesser Black-backed Gulls in the German Bight. Swimming crabs *Liocarcinus* sp. were exploited primarily close to the coast while Lesser Black-backed Gulls at larger distances from the coast were mainly feeding on other natural prey (e.g. schooling fish) and discarded fish from trawlers.

Recent technology and the use of electronic data loggers has now provided deeper insight in foraging behaviour at sea, but such data are essentially mono-specific and should be complemented by dedicated and critical observations at sea of inter- and intra-specific behaviour. Keen but critical observers, categorising behaviour and using the coding structure suggested here, will be able to provide quantified insight in species-specific roles of seabirds and marine mammals in particular feeding assemblages during their numerous encounters with MSFA's in various stages of development and disintegration.

This method has an important limitation, namely the number of observers required. While one observer has been the norm for several ESAS partners over the years (usually due to cost or accommodation availability), this is not enough to record behaviour and foraging associations in sufficient detail.

The most spectacular phenomena will be encountered in high density areas, areas in which working with only one observer usually is difficult even if just plain numbers in transect need to be recorded. We recommend that two observers are a minimum, with three an ideal.

Counting is easy and fairly straightforward, perhaps less so with big groups and elusive species. Recording behaviour however, can be more subjective. One should always try to record what can be seen, not what one would like to see, or what one might think can be seen. There is no need to label every individual in as much detail as possible, certainly not if the quality of the record will go down by spending too little time to watch before you record. Close co-operation with the 'counting observer' is essential to provide valuable data and to successfully find and classify important feeding areas or interesting and maybe completely unexpected behaviour patterns. The feeding techniques listed in Appendix 1 may be typical for certain groups or species, but do they always use these techniques or have they more options? Can we deduce something of their prey and foraging opportunities from the way they exploit patches and are there spatial and temporal patterns in foraging activity and/or techniques? One should always realise, that the coding and database storage is no more than a tool, an electronic instrument facilitating analysis. Keen recorders should always make notes about what they encounter, frequently discuss and describe their results and problems or reservations, and preferably combine their efforts with other techniques and sources of information, both at sea and in colonies.

ACKNOWLEDGEMENTS

We would like to thank Mardik Leopold, Jaap van der Meer, Philipp Schwemmer, Nicole Sonntag, Andy Webb, Tanja Weichler and Richard White for fruitful discussions during test-cruises and try-out sessions using and developing behaviour coding. Mark Tasker, Andy Webb and Sabina Wilhelm kindly read and commented on previous drafts. This paper is produced as part of the IMPRESS project and was initially made available as IMPRESS report #2001-001, EC Quality of Life and Management of Living Resources; Key action QOL-2000-5.1.2. Sustainable fisheries and aquaculture, Contract Q5RS-2000-30864.

DE REGISTRATIE VAN FOERAGERENDE ZEEVOGELS OP ZEE: EEN SYSTEEM VOOR HET GESTANDAARDISEERD CODEREN VAN GEDRAG EN INTERACTIES TUSSEN FOERAGERENDE ZEEVOGELS EN ZEEZOOGDIEREN

In Europa werd begin jaren tachtig een centrale gegevensbank ingesteld ('ESAS database') waarin gestandaardiseerde tellingen van zeevogels op zee op uniforme wijze konden worden opgeslagen. Zeker in de eerste jaren was het hoofddoel van dit project het zo snel mogelijk inventariseren van een zo groot mogelijke oppervlakte zee (vandaar internationale samenwerking), om regionale verschillen in kwetsbaarheid voor oppervlakte vervuilende stoffen te kunnen aangeven. Het ging dus om tellingen op grond waarvan verspreidingspatronen konden worden uitgerekend en aan de hand waarvan het mogelijk was om schattingen van populatieomvang te maken. In latere jaren kwamen meer ecologische vragen aan de orde, omdat toen de verspreiding wel redelijk bekend was, maar de onderliggende factoren die de verspreiding en verschillen in talrijkheid bepaalden nog maar nauwelijks begrepen konden worden. In sterk toenemende mate werd toen ook de behoefte gevoeld om meer inzicht te krijgen in het gedrag van vogels op zee (vooral het foerageergedrag) en in de inter- en intraspecifieke interacties van zeevogels en zeezoogdieren op zee.

In dit artikel wordt een systeem voorgesteld waarbij door een eenvoudige codering tal van gedragingen en onderlinge of soortspecifieke associaties in de gegevensbank kunnen worden vastgelegd, zonder dat het oorspronkelijke doel van de waarnemingen op zee (ruimtelijke inventarisaties) daardoor wordt aangetast. Nieuw ingevoerde gegevens blijven daardoor volledig vergelijkbaar met het al verzamelde materiaal, maar de volgens het nieuwe systeem verzamelde gegevens zullen wel veel meer informatie verschaffen, waardoor na selectie van de gegevens betere correlaties met onderliggende factoren verwacht mogen worden. Net als tot dusverre worden voor elke waargenomen vogel (of zeezoogdier) de plaats, tijd, soort, leeftijd, kleed, het aantal en de eventuele vliegrichting geregistreerd, maar daarnaast kunnen gegevens worden opgeslagen over oppervlaktefenomenen waarmee de dieren geassocieerd voorkomen, zoals vissersschepen, fronten, drijfvuil, of land). Tal van gedetailleerd beschreven foerageertechnieken of andere gedragingen kunnen precies gecodeerd worden, in combinatie met de genoemde associaties of de eventuele 'deelname aan' samengestelde groepen foeragerende zeevogels (multi-species feeding associations, MSFA's), en een eventueel herkende prooi. Ook voor walvisachtigen zijn een twintigtal codes gereserveerd, aan de hand waarvan de meest voorkomende gedragingen eenvoudig kunnen worden geduid. Tenslotte zijn er enkele codes gereserveerd om digitale aantekeningen te kunnen maken over vogels in stress situaties, zoals wanneer ze door een predator of kleptoparasiet worden aangevallen, of wanneer ze bijvoorbeeld in vistuig verstrikt of met olie besmeurd blijken te zijn. Het systeem van coderingen is in de eerste plaats bedoeld voor tellingen van zeevogels op zee voor de de ESAS gegevensbank, maar anderen die in het gedrag van zeevogels geïnteresseerd zijn kunnen hier hun voordeel mee doen. De voorgestelde classificaties kunnen beheerders van gegevens en monitoringprogramma's bovendien misschien bruikbare ideeën opleveren.

DIE ERFASSUNG VON NAHRUNGSSUCHENDEN SEEVÖGELN AUF SEE: EIN SYSTEM ZUR STANDARDISIERTEN ERFASSUNG UND CODIERUNG DES VERHALTENS UND DER INTERAKTIONEN VON NAHRUNGSSUCHENDEN SEEVÖGELN UND MEERESSÄUGETIEREN

In Nordwest-Europa werden seit Beginn der 1980er Jahre Seevögel auf See nach einer standardisierten Methode erfasst. Die Zählungen erfolgen von Schiffen und Flugzeugen aus und werden in einer zentralen Datenbank (der European Seabirds at Sea [ESAS]-Database) in einem gemeinsam abgestimmten Datenbankformat gespeichert. Der Schwerpunkt des Programmes lag viele Jahre auf der Beschreibung von Seevogel-Verbreitungsmustern und Häufigkeiten sowie ihren räumlich-zeitlichen Schwankungen. Auf dieser Basis konnten Bestandsangaben für bestimmte Seegebiete ermittelt werden.

Die großräumigen Daten wurden in erster Linie dazu verwendet, verschiedene Meeresgebiete bezüglich ihrer Verwundbarkeit gegenüber Verölung und anderen oberflächennahen Verschmutzungen zu beurteilen. Spätere Studien betonten dann stärker die ökologischen Aspekte, die den beobachteten Verbreitungsmustern und ihrer Variabilität zugrundeliegen. Aus dieser Arbeit heraus enstand der Bedarf, umfangreichere und stärker standardisierte Protokollierungen des Verhaltens von Seevögeln auf See vorzunehmen, insbesondere hinsichtlich Nahrungssuche und -erwerb.

In diesem Artikel wird ein System vorgestellt, welches es ermöglicht, spezifische Codierungen zum Verhalten von Seevögeln und Meeressäugetieren vorzunehmen. Diese beziehen sich zum einen auf Assoziierungen von Tieren mit oberflächennahen Strukturen und Objekten (z.B. hydrographische Fronten, Treibgut, Fischkutter) und Truppbildungen beim Nahrungserwerb (multi-species feeding associations), letztere oft mit zwischenartlichen Interaktionen (Appendix 1). Zum anderen werden vielfältige Angaben zum Verhalten von Seevögeln und Meeressäugern ermöglicht (Appendix 2). Dabei werden dem Nahrungserwerb die detailliertesten Codes zugeordnet, es werden aber auch Angaben zum allgemeinen Verhalten von Seevögeln und Meeressäugern spezifiziert. Ferner wird eine Liste von Beuteobjekten vorgelegt, deren Aufnahme durch Seevögel bei guten Bedingungen und gewisser Beobachter-Erfahrung erkennbar ist. Alle Codierungen sind so angelegt, dass die ursprüngliche Art und Weise, Daten zur Erfassung von Seevögeln auf See zu sammeln, erhalten bleibt, und auch neu gesammeltes Material mit dem alten vergleichbar bleibt. Insofern dürften diese Codierungen im Speziellen sowohl für Mitglieder von ESAS als auch für andere Gruppen sowie das grundsätzliche Prinzip von allgemeinem Interesse sein.

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Appendix 1. Flight direction & association codes Codes voor vliegrichting en associaties (A-codes)

Code	Description in short	Category	Explanation
1	Flying, no apparent direction	Flight directions	Directions of flight (octants) only for determined, direct movements; to be overruled by any of the following associat-ion codes if the goal of move-ments can be identified. Directions of flight are most important for movements to and from breeding colonies.
2-9	Heading N, NE, E, SE, S, SW, W, NW N NW 2 NE 9 3 W 8 1 4 E 7 5 SW 6 SE S	Flight directions	
10	Associated with fish shoal	Associations	Seabirds or marine mammals operating at or staying near any of the listed phenomena at the sea surface
11	Associated with cetaceans	Associations	
12	Associated with front	Associations	
13	Associated with line in sea	Associations	
14	Sitting on or near floating wood	Associations	
15	Associated with floating litter	Associations	
16	Associated with oil slick	Associations	
17	Associated with floating seaweed	Associations	
18	Associated with observation base	Associations	Interactions with observation platform (by default as "out of transect")
19	Sitting on observation base	Associations	
20	Approaching observation base	Associations	
21	Associated with other vessel	Associations	Seabirds or marine mammals operating at or staying near any of the listed phenomena at the sea surface
22	Associated with or on buoy	Associations	
23	Associated with offshore platform	Associations	
24	Sitting on offshore platform	Associations	
25	Sitting on marking pole or stick	Associations	
26	Associated with fishing vessel	Associations	Moving towards (no behav. code), feeding at (combine with behav. #41) or resting near (behav. #60) fishing vessel
27	Associated with or on sea ice	Associations	See #10-17, 21-25
28	Associated with land (e.g. colony)	Associations	Colony rafts only, birds flying to and from breeding colonies should preferably be coded with precise directions of flight
29	Associated with shallows or sand banks	Associations	See #10-17, 21-25

Multi-species foraging associations (MSFA's) have numerous species operating in a joint effort to exploit a shared resource. Each species can be assigned a specific role in a given feeding frenzy after careful observations and the coding protocol will offer opportunities to code these activities in a combination of Association codes (#A 50-59), highlighting the type of MSFA seen and some aspects of the behaviour of the birds/mammals involved in the frenzy, and foraging behaviour in the Behaviour code column, as outlined in Appendix 2 (B-codes). Codes # A51-56 apply for small, short-lived flocks over tightly clumped prey, with producers (birds or mammals) driving prey towards the surface. Codes #A 57-58 apply for larger and longer-lasting flocks formed over prey that apparently do not act as cohesive units (#A 57) and for very large flocks formed where local water-mass discontinuities concentrate zooplankton or small fish (#A 58), often areas where several smaller frenzies occur with prey scattered over a larger area (could be numerous small MSFA's as #A 51-56). Code #A59 applies for large frenzies attacking a single prey patch that is apparently not driven towards the surface by any of the top-predators. Drive hunts are characterised by continuous movements and the frequent repositioning of predators to obtain optimal attack positions.

50	MSFA participant	MSFA's	Participating in MSFA but specific role unclear
51	MSFA participant, joined by others	MSFA's	Initiator, surface feeder by default, of MSFA; first surface feeder at the scene (usually small gulls or terns)
52	MSFA participant, joining flock	MSFA's	Second or subsequent species joining frenzy; non-aggressive behaviour, clearly not fully excluding access of competitors in the feeding frenzy (usually small gulls, shearwaters or terns); auks may actively join MSFA's by flying in from elsewhere
53	MSFA participant, scrounger type	MSFA's	Second or subsequent species joining frenzy; aggressive behaviour fully excluding access of initiators and other participants in the feeding frenzy (usually Northern Gannets, large gulls, or even Northern Fulmars)
54	MSFA participant, solitary diver	MSFA's	Producer at the scene, diving seabird by default, or simple participant in the frenzy, not diving in concerted action (e.g. large auks or Atlantic Puffin)
55	MSFA participant, beater	MSFA's	Producer at the scene, marine mammal by default, driving prey or otherwise supporting surface feeding seabirds by their foraging behaviour (e.g. Harbour Porpoise, dolphins)
56	MSFA participant, social feeder	MSFA's	Producer at the scene, diving seabird by default, diving in concerted action to drive prey towards the surface (diving and surfacing simultaneously; usually Common Guillemots or Razorbills, also cormorants)
57	Type II MSFA participant	MSFA's	Participant in any of numerous smaller feeding frenzies in an area with scattered prey patches
58	Type III MSFA participant	MSFA's	Participant in any of numerous smaller feeding frenzies in a large and predictable area with scattered prey patches (e.g. an offshore front)
59	Drive hunt MSFA participant	MSFA's	Participant in large feeding frenzies, attacking a single prey patch that is apparently not driven towards the surface by any of the top-predators. Drive hunts are characterised by continuous movements and the frequent repositioning of predators to obtain optimal attack positions.

Appendix 2. Behaviour codes Gedragscodes (B-codes)

Code	Description in short	Category	Explanation
30	Holding or carrying fish	Foraging	Carrying fish towards colony (e.g. terns, auks)
31	Without fish	Foraging	Colony flights, not carrying prey (e.g. terns, auks) used in combination with #30
32	Feeding young at sea	Foraging	Code for adult birds presenting prey to attended chicks (e.g. auks) or juveniles (e.g. terns)
33	Feeding, method unspecified	Foraging	
34	Wading, filtering or probing	Foraging	For shallow areas such as the Wadden Sea where foraging waders may occur even within transect
35	Scooping prey from surface	Foraging	Swimming birds, scooping up small prey from just below the surface, common in pelicans and Northern Gannets
36	Aerial pursuit	Foraging	Skuas or gulls in aerial pursuit to kleptoparasitise or kill their target. To be used in combination with codes #90 and #91 for the victim. Sea also #68 for "non-aerial" kleptoparasitism.
37	Skimming	Foraging	Low flight over the water surface, touching the surface with the beak (e.g. skimmers, drinking terns)
38	Hydroplaning	Foraging	Low flight over the water, filtering surface layers (e.g. prions)
39	Pattering	Foraging	Low flight over the water, zig-zag course usually, tapping the surface with feet while still airborne (e.g. storm petrels)
40	Scavenging	Foraging	Swimming at the surface, handling carrion, corpse or large fish (e.g. Northern Fulmar, Great Skua, large gulls)
41	Scavenging at fishing vessel	Foraging	Foraging at fishing vessel, deploying *any* method to actually obtain discarded fish and offal; storm-petrels in the wake of trawlers picking up small morsels should be excluded.
42	Dipping	Foraging	Aerial seabirds (e.g. skuas, small gulls, terns) making repeated dives while hardly touching the water (remain airborne) and picking up small prey
43	Surface seizing	Foraging	Swimming birds seizing floating (large) prey (e.g. Northern Fulmar, large gulls)
44	Surface pecking	Foraging	Swimming birds pecking at small prey (e.g. Northern Fulmar, phalaropes,

Code	Description in short	Category	Explanation
			small skuas, small gulls)
45	Deep plunging	Foraging	Aerial seabirds diving into the sea and completely disappearing under water (e.g. Northern Gannets). See also #46
46	Shallow plunging	Foraging	Aerial seabirds diving into the sea and partly disappearing under water (e.g. terns). See also #42 and #46
47	Pursuit plunging	Foraging	Aerial seabirds plunging into the water and continuing with an underwater pursuit (e.g. shearwaters)**
48	Pursuit diving, or bottom feeding	Foraging	Swimming seabirds that perform deep dives and are known to search for prey in an underwater pursuit (divers, grebes, seaduck, auks) or search for prey at the bottom (e.g. Common Eider, scoters)
49	Actively searching	Foraging	Persistently circling aerial seabirds (usually peering down), or swimming birds frequently (and undisturbed by observation platform) peering underwater for prey.
60	Resting or apparently asleep	General	Reserved for sleeping seabirds at sea, or resting birds around feeding frenzies (e.g. fishing vessels or recently collapsed MSFA's).
61	Courtship display	General	Aerial displays (e.g. terns) or courtship behaviour on water or while seated on floating matter (buoys, driftwood)
62	Courtship feeding	General	Display fish presented during courtship display at sea (e.g. terns)
63	Copulating	General	Atlantic Puffins copulate at sea; male scoters may persistently follow solitary females at sea
64	Carrying nest material	General	Flying with seaweed or other material; not to be confused with entangled birds with nylon line around the beak (#96)
65	Guarding chick	General	Reserved for auks attending recently fledged chicks at sea
66	Preening or bathing	General	
67	Colony rafts	General	Reserved for the large flocks of birds "rafting" at sea near breeding colonies engaged in multiple behaviours including maintenance
68	Kleptoparasitising	Foraging	Reserved for kleptoparasites that steal prey not during an aerial pursuit, but

* Underwater pursuit is part of the foraging behaviour of many deep-plunging Northern Gannets, but code #47 is normally reserved for shearwaters. Large auks may engage in drive hunts where the birds approach a feeding frenzy from the air and plunge into the frenzy to disappear under water straight away. Such auks are coded as #47 also.

Code	Description in short	Category	Explanation
			otherwise (e.g. Black-legged Kittiwakes stealing prey from surfacing Atlantic Puffins). Compare with #36 for aerial pursuit.
69	Circling high	General	High circling seabirds (mainly gulls)
70	Wheeling or swimming slowly	Cetaceans	Slow movement, no white crests
71	Escape from ship (rooster tail)	Cetaceans	Quick escape movements away from observation platform; splashes
72	Swimming fast, not avoiding ship	Cetaceans	Fast movements seemingly unaffected by observation platform; splashes
73	Breaching clear out of the water	Cetaceans	Vertical leap, sometimes clear of the water
74	At the bow of the ship	Cetaceans	Bow riding dolphins
75	Apparently feeding: herding behaviour	Cetaceans	Group feeding behaviour where more individuals try to herd prey towards the water surface or concentrate prey in an U-shaped move around fish shoals
76	Apparently feeding: other behaviour	Cetaceans	Other feeding behaviour, not specified, including lunge-feeding baleen whales
77	Calf at the tail of adult	Cetaceans	Immature whales or dolphins constantly staying close to the side of an adult
78	Calf swimming freely in herd	Cetaceans	Immature whales or dolphins anywhere in the herd, except close to the side of an adult
79	Basking, afloat	Cetaceans	Constantly visible marine mammals, often with dorsal fin exposed, floating at the sea surface
80	Spy-hopping	Cetaceans	Head sticks out the water (including the eyes), apparently to look around. Also to be used for seals where appropriate
81	Lob-tailing	Cetaceans	Code for cetaceans showing flukes while diving
82	Tail/flipper slapping	Cetaceans	Cetaceans smashing tail on water surface or waving flippers or tail above surface
83	Approaching ship	Cetaceans	Marine mammals approaching the observation vessel (including wake and stern), not bow riding
84	Only blow visible (whales)	Cetaceans	Usually unidentified whale, of which no more than a blow was visible
85	Only splashes visible (dolphins)	Cetaceans	Usually unidentified marine mammals, of which no more than splashes at the surface were visible
86	Acrobatic leaps	Cetaceans	Marine mammals (mostly dolphins) acrobatically leaping out of the water in any direction, often landing with large splashes (see also #73)
87	Sexual behaviour	Cetaceans	Any sexual behaviour (copulations) observed by marine mammals
88	Play	Cetaceans	Any behaviour observed by marine

Code	Description in short	Category	Explanation
			mammals that could be play, such as interactions with floating material (driftwood or seaweed)
89	Haul-out (pinnipeds)	General	Resting seals on rocks or sandbanks
90	Under attack by kleptoparasite	Misfortune	Bird (e.g. Northern Gannet, tern, or gull) under attack by kleptoparasite (e.g. skua, gull or frigate bird) in an aerial pursuit, or when handling prey at the surface
91	Under attack (as prey) by bird	Misfortune	Bird chased by potential predator
92	Under attack (as prey) by marine mammal	Misfortune	Bird attacked following underwater assault by marine mammal
93	Escape diving	Misfortune	Mainly used for moulting seaduck, unable to fly, escaping from approaching observation platform
94	*Unassigned as yet*		
95	Injured	Misfortune	Animals with clear injuries such as broken wings, bleeding wounds
96	Entangled in fishing gear or rope	Misfortune	Animals entangled in ropes, lines, netting or other materials (even if stil capable to fly or swim)
97	Oiled	Misfortune	Animals contaminated with mineral oil, or other lipophilic substances damaging the plumage
98	Sick, unwell	Misfortune	Weakened individuals, not behaving as normal, healthy animals would do, but without obvious injuries
99	Dead	Misfortune	Any floating corpse of a bird or marine mammal (by default recorded as "out of transect").